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THE HEAD-FORMS OF THE ITALIANS AS INFLUENCED BY HEREDITY AND ENVIRONMENT

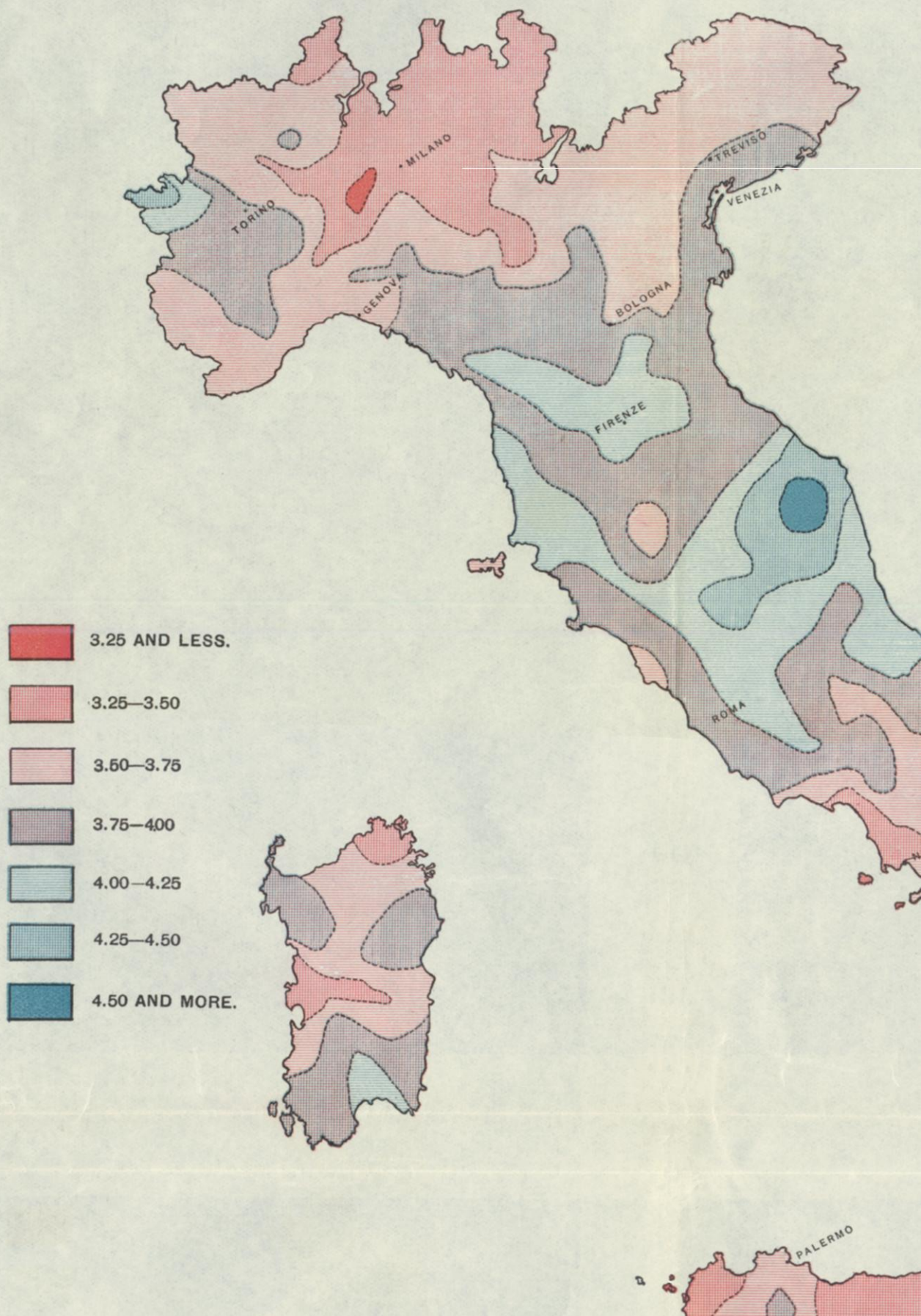
BY FRANZ BOAS AND HELENE M. BOAS

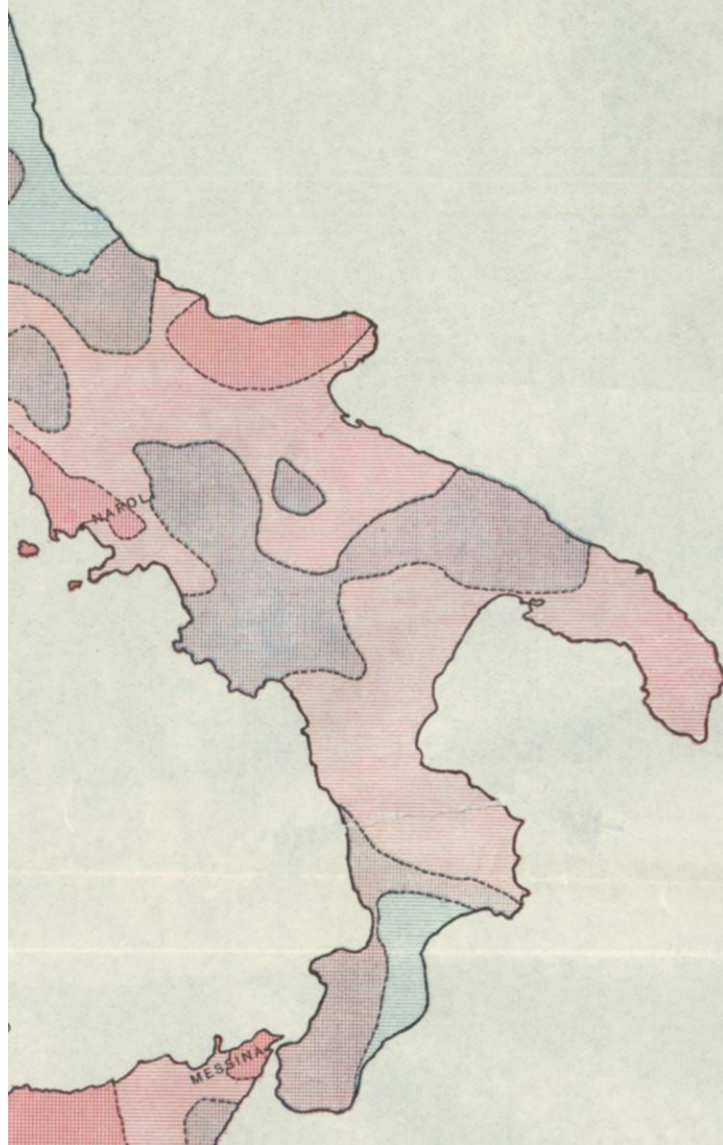
THE investigation of the head-forms of immigrants who come to the United States has shown that the head-forms of man are not quite stable when individuals belonging to a certain type are brought into a new environment. On the other hand, there is also evidence of a great stability of types and of the occurrence of several distinct types in the same area and in the same environment. Although these two observations are apparently contradictory, the phenomena may very well exist side by side, since the modification of types under environmental influences does not necessarily imply that distinct types will converge to a uniform type in the same environment.

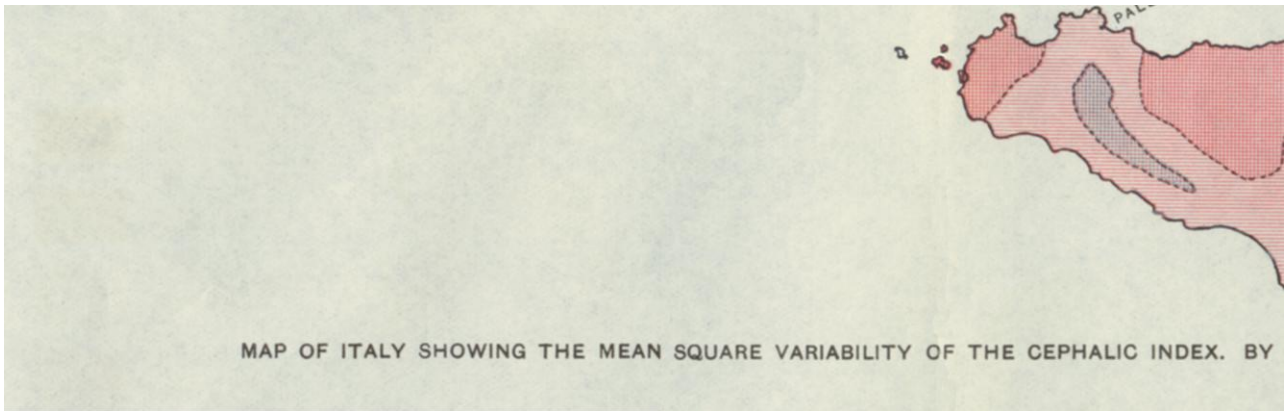
Lack of stability of types has been observed by Ammon in Baden¹ and by Livi² in Italy, in their comparisons of urban and rural types. It has been brought forward recently by Johannes Ranke as explaining the differences between the population of the Alps and of southern Germany—differences which have continued through a long period. In all these cases it is conceivable that the populations compared may have a different composition, owing either to migration or to selective causes. The observations on American immigrants, however, show that there is also a difference

¹ *Natürliche Auslese beim Menschen*, 1893. *Zur Anthropologie der Badener*, 1899.

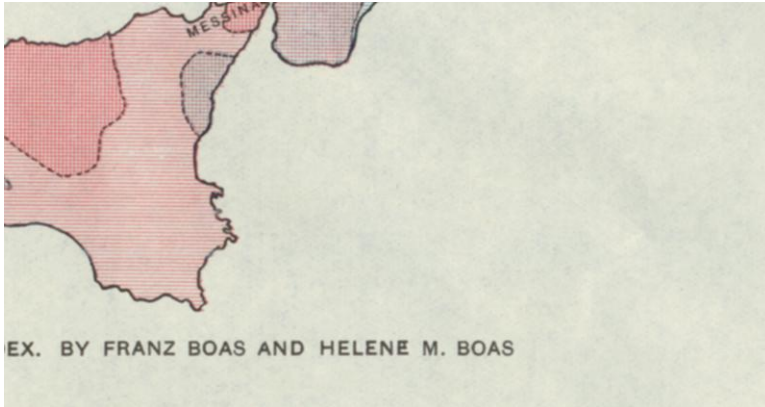
² *Antropometria Militare*, 1896.







MAP OF ITALY SHOWING THE MEAN SQUARE VARIABILITY OF THE CEPHALIC INDEX. BY



EX. BY FRANZ BOAS AND HELENE M. BOAS

between parents who have grown up in one environment and their children who were born in another environment.

The tendency of racial types to revert to their ancestral types, and not to form a new intermediate type, was first observed by Felix von Luschan¹ in his studies on the types of Asia Minor. His later studies have corroborated these observations. Since the mixture in Asia Minor has extended over a very long period, this observation is particularly important. Among the Jews of America it has been found that the variability of head-index of children of a family increases considerably with increasing difference of type of parents.² Whether or not these observations can be explained as conforming to some type of Mendelian inheritance cannot be stated. Various observations relating to color, which have been interpreted as expressing Mendelian inheritance in man, may also be adduced as proving the permanence of certain types.³ For the first generation of hybrids a similar phenomenon was observed among American Indian half-bloods, whose width of face tends to revert to a type similar either to the European or to the American Indian type.⁴

It has seemed desirable to extend this study over new material; and we have investigated for this purpose the extended anthropometric tables in Ridolfo Livi's *Antropometria Militare*.

It so happens that in Italy two types quite distinct in head-form inhabit the extreme northern and the extreme southern part of the country. In the region of central Italy the two types have been in long-continued contact, and have consequently intermingled.

¹ Die Tachtadschy und andere Ueberreste der alten Bevölkerung Lykiens, *Archiv für Anthropologie*, vol. XIX, pp. 1-23; Petersen und von Luschan, *Reisen in Lykien, Milyas und Kibyratis*, Vienna, 1889.

² Franz Boas, *Changes in Bodily Form of Descendants of Immigrants*, New York, Columbia University Press, 1912.

³ See, for instance, G. and Ch. Davenport, Heredity of Hair Colour in Man, *American Naturalist*, vol. 43, pp. 193-211; W. Weinberg, Ueber Vererbungsgesetze beim Menschen, *Zeitschrift für induktive Abstammungs- und Vererbungslehre*, vol. I, 1909, pp. 377-392, 440-460; vol. II, pp. 276-330; E. Fischer, Rassen und Rassenbildung, *Handwörterbuch der Naturwissenschaften*, vol. VIII, pp. 78 et seq.

⁴ Franz Boas, Zur Anthropologie der nordamerikanischen Indianer, *Verhandlungen der Berliner Gesellschaft für Anthropologie, Ethnologie und Urgeschichte*, vol. 27, 1895, p. 406 et seq.

It seemed plausible, therefore, that if the head-forms of mixed types tend to revert to the ancestral forms, in the north and south of Italy the variabilities of head-form should be low, in the central area high, because here both distinct types would be represented in the population.

We have therefore calculated the variability (standard or mean square variation) for each *circondario*, and have plotted the results on the accompanying map (pl. III), in which areas of equal variability are represented by the same tint. It will be seen at once that, on the whole, the highest variabilities are found in the central parts of Italy, and the lowest in the north and south; so that the theory with which we started appears to be borne out by the facts.

This result may also be expressed as follows: We find in central Italy two types of head-form represented, both with moderate variabilities, but with different averages,—that of southern Italy with a low average, that of northern Italy with a high average. The variabilities of these two types bring it about that we find in the population of the district in question very low values which belong to the South Italian type, and very high values which belong to the North Italian type; so that the whole area has a wide range of variation, which is expressed by a high variability. If a uniform intermediate type should develop through mixture, we should expect a lesser range of variation than we actually find.¹

The determination of the variability could not be made directly from the series of *circondari* given in Livi's lists (pp. 205–229), because most of these districts are so large that the average index

¹ The effect of a purely mechanical mixture has been discussed by Livi (*Archivio per l'Antropologia e la Etnologia*, vol. XVI, pp. 254 et seq.; and *Antropometria Militare*, p. 29). He has shown that by mechanical mixture of two distinct types the variability would be increased, and has utilized this observation in the discussion of the amount of spreading of the curves of various *circondari*, without, however, stating in detail the variabilities and discussing the effects of intermarriage.

After the present paper was in type, we received Professor Corrado Gini's paper *Variabilità e Mutabilità* (Bologna, 1912), in which he calls attention to the greater variabilities found in the central parts of Italy as compared with the southern and northern parts of the peninsula (p. 31). He treats, however, only the larger units, the variabilities of which are increased on account of the differences of local types contained in them.

CIRCONDARIO	CE- PHALIC INDEX	VARIA- BILITY	CORRECTED VARIA- BILITY	NUMBER OF CASES
Acqui	84.4	± 3.66	± 3.56	1191
Alessandria	85.1	± 3.48	± 3.42	1647
Asti	86.1	± 3.97	± 3.94	2063
Casale	86.2	± 3.70	± 3.64	1664
Novi	82.2	± 3.75	± 3.68	1038
Tortona	83.7	± 3.69	± 3.58	756
Alba	85.8	± 3.78	± 3.76	1438
Cuneo	86.6	± 3.73	± 3.66	1849
Mondovi	85.2	± 4.14	± 3.86	1696
Saluzzo	85.6	± 3.97	± 3.85	1724
Biella	86.6	± 3.85	± 3.81	1725
Domodossola	86.1	± 3.35	± 3.34	414
Novara	86.5	± 3.61	± 3.47	2528
Pallanza	86.5	± 3.64	± 3.62	767
Varallo	86.3	± 3.63	± 3.62	337
Vercelli	85.4	± 3.50	± 3.39	1671
Aosta	87.6	± 3.54	± 3.52	843
Ivrea	87.7	± 3.56	± 3.54	2051
Pinerolo	86.2	± 4.09	± 3.94	1521
Susa	85.8	± 4.42	± 4.36	948
Torino	86.1	± 3.79	± 3.72	4919
Albenga	81.9	± 3.77	± 3.68	543
Chiavari	82.6	± 4.03	± 3.95	1178
Genova	82.4	± 3.73	± 3.69	3337
Savona	83.0	± 3.64	± 3.62	946
Spezia	81.3	± 3.88	± 3.81	768
Porto Maurizio	82.1	± 3.57	± 3.47	531
San Remo	82.2	± 3.82	± 3.77	648
Bergamo	84.4	± 3.45	± 3.41	2407
Clusone	84.8	± 3.28	± 3.24	557
Treviglio	84.0	± 3.25	± 3.24	1116
Breno	84.5	± 3.36	± 3.31	555
Brescia	82.9	± 3.57	± 3.55	1895
Chiari	83.4	± 3.33	± 3.31	713
Salò	82.4	± 3.44	± 3.42	489
Verolanuova	84.0	± 3.57	± 3.57	580
Como	84.5	± 3.46	± 3.44	2791
Lecco	84.1	± 3.56	± 3.52	1367
Varese	85.3	± 3.34	± 3.25	1739
Casalmaggiore	85.5	± 3.26	± 3.26	440
Crema	84.2	± 3.44	± 3.43	730
Cremona	85.0	± 3.49	± 3.43	1726
Mantova	85.3	± 3.78	± 3.74	2802
Abbiategrosso	84.3	± 3.27	± 3.24	1168
Gallarate	83.8	± 3.34	± 3.31	1847
Lodi	85.3	± 3.45	± 3.42	1771
Milano	84.1	± 3.34	± 3.32	3550
Monza	84.4	± 3.57	± 3.55	1960
Bobbio	84.1	± 3.88	± 3.85	500

CIRCONDARIO	CE- PHALIC INDEX	VARIA- BILITY	CORRECTED VARIA- BILITY	NUMBER OF CASES
Mortara.....	84.2	±3.18	±3.17	1574
Pavia.....	84.7	±3.62	±3.59	1480
Voghera.....	83.4	±3.79	±3.70	1357
Sondrio.....	85.7	±3.56	±3.48	1088
Belluno.....	85.2	±3.61	±3.59	2258
Padova.....	85.3	±3.72	±3.70	3921
Rovigo.....	84.6	±3.74	±3.72	2042
Treviso.....	85.2	±3.70	±3.69	3983
Udine.....	85.0	±3.69	±3.66	5289
Venezia.....	85.0	±3.86	±3.86	3094
Verona.....	84.4	±3.79	±3.67	3759
Vicenza.....	85.0	±3.59	±3.58	3833
Bologna.....	84.4	±3.75	±3.72	3576
Imola.....	86.1	±4.09	±4.08	772
Vergato.....	83.2	±3.91	±3.91	604
Cento.....	84.6	±3.71	±3.68	379
Comacchio.....	85.0	±3.84	±3.84	355
Ferrara.....	84.7	±3.51	±3.48	1654
Cesena.....	86.1	±3.76	±3.75	1030
Forlì.....	86.1	±4.00	±4.00	820
Rimini.....	85.7	±3.85	±3.84	1046
Mirandola.....	85.4	±3.83	±3.83	797
Modena.....	84.7	±3.91	±3.89	1513
Pavullo.....	85.2	±3.91	±3.91	867
Borgo S. Donnino.....	85.8	±3.76	±3.75	863
Borgotaro.....	84.7	±3.94	±3.93	409
Parma.....	84.6	±3.90	±3.79	1499
Fiorenzuola.....	85.6	±3.63	±3.63	881
Piacenza.....	84.6	±3.79	±3.68	1529
Faenza.....	86.8	±3.98	±3.98	917
Lugo.....	86.5	±3.87	±3.87	870
Ravenna.....	86.6	±3.86	±3.84	1019
Guastalla.....	86.0	±3.60	±3.59	774
Reggio Emilia.....	85.1	±3.84	±3.78	2057
Arezzo.....	83.9	±3.92	±3.90	2206
Firenze.....	82.9	±4.29	±4.17	4788
Pistoia.....	83.1	±4.24	±4.24	1262
Rocca San Casciano.....	85.5	±4.16	±4.10	557
San Miniato.....	83.0	±4.05	±3.83	1183
Grosseto.....	83.0	±4.02	±3.97	1089
Livorno.....	79.9	±4.09	±4.09	941
Portoferraio.....	78.4	±3.73	±3.67	199
Lucca.....	79.7	±4.32	±3.95	3475
Castelnuovo Garfagnana.....	78.2	±4.13	±4.11	574
Massa.....	80.3	±4.33	±4.11	1057
Pontremoli.....	83.3	±3.83	±3.75	394
Pisa.....	82.5	±4.11	±4.01	2480
Volterra.....	83.5	±4.18	±4.09	702
Montepulciano.....	83.4	±3.72	±3.59	755

CIRCONDARIO	CE- PHALIC INDEX	VARIA- BILITY	CORRECTED VARIA- BILITY	NUMBER OF CASES
Siena	84.0	± 4.08	± 4.01	1360
Ancona	84.0	± 4.53	± 4.40	2953
Ascoli Piceno	81.8	± 4.55	± 4.30	1086
Fermo	84.2	± 4.29	± 4.11	1209
Camerino	81.5	± 4.47	± 4.44	590
Macerata	83.7	± 4.75	± 4.68	2207
Pesaro	85.4	± 4.13	± 4.02	1154
Urbino	85.8	± 3.89	± 3.88	1410
Foligno	84.2	± 4.37	± 4.35	742
Orvieto	83.8	± 3.91	± 3.91	588
Perugia	84.7	± 4.04	± 4.01	2315
Rieti	83.4	± 4.27	± 4.19	914
Spoletto	83.4	± 4.31	± 4.25	867
Terni	84.5	± 4.37	± 4.35	783
Civitavecchia	81.5	± 3.71	± 3.70	204
Frosinone	81.9	± 4.22	± 4.04	1677
Roma	80.2	± 4.10	± 4.01	3275
Velletri	80.2	± 3.96	± 3.86	823
Viterbo	81.7	± 4.29	± 4.11	1919
Aquila	81.2	± 4.06	± 3.95	1301
Avezzano	80.3	± 3.69	± 3.64	1188
Cittaducale	81.7	± 4.25	± 4.09	645
Sulmona	81.0	± 3.84	± 3.72	1025
Campobasso	81.3	± 3.76	± 3.62	1326
Isernia	82.0	± 3.74	± 3.69	1498
Larino	81.5	± 3.52	± 3.46	1002
Chieti	83.5	± 4.40	± 4.33	1175
Lanciano	83.5	± 4.26	± 3.93	1237
Vasto	82.8	± 4.08	± 3.99	1348
Penne	82.3	± 4.29	± 4.12	1008
Teramo	81.2	± 3.97	± 3.91	1621
Ariano	81.2	± 4.01	± 3.89	920
Avellino	81.9	± 3.90	± 3.85	1860
Sant' Angelo de' Lombardi	80.7	± 4.01	± 4.00	1315
Benevento	81.7	± 4.03	± 3.86	970
Cerreto Sannita	80.7	± 3.94	± 3.71	737
San Bartolomeo in Galdo	80.7	± 3.75	± 3.66	609
Caserta	81.6	± 3.56	± 3.53	2903
Gaeta	80.2	± 3.50	± 3.48	1476
Nola	82.4	± 3.42	± 3.40	947
Piedimonte d'Alife	81.6	± 3.68	± 3.65	503
Sora	83.2	± 4.22	± 3.87	1578
Casoria	82.0	± 3.37	± 3.36	1544
Castellamare di Stabia	82.9	± 3.58	± 3.54	1480
Napoli	82.6	± 3.55	± 3.55	5543
Pozzuoli	83.4	± 3.50	± 3.39	542
Campagna	81.9	± 3.82	± 3.74	1142
Sala Consilina	82.7	± 3.89	± 3.73	923
Salerno	83.4	± 3.62	± 3.59	2588

CIRCONDARIO	CE- PHALIC INDEX	VARIA- BILITY	CORRECTED VARIA- BILITY	NUMBER OF CASES
Vallo Lucania.....	81.8	±4.02	±3.91	1034
Altamura.....	81.1	±4.11	±3.93	1118
Bari.....	81.0	±4.15	±3.96	3076
Barletta.....	80.2	±3.79	±3.54	3091
Bovino.....	80.2	±3.55	±3.51	527
Foggia.....	80.3	±3.71	±3.67	1443
Sansevero.....	80.2	±3.48	±3.35	1308
Brindisi.....	79.3	±3.83	±3.70	1250
Gallipoli.....	77.9	±3.71	±3.67	1457
Lecce.....	77.5	±3.71	±3.65	1395
Taranto.....	79.2	±3.98	±3.91	1412
Lagonegro.....	79.4	±4.06	±3.76	1518
Matera.....	81.5	±3.70	±3.56	957
Melfi.....	80.4	±3.57	±3.45	1315
Potenza.....	81.7	±4.01	±3.75	2108
Catanzaro.....	78.7	±4.22	±4.15	1135
Cotrone.....	78.2	±3.64	±3.55	516
Monteleone.....	77.9	±4.07	±3.93	1100
Nicastro.....	79.0	±4.21	±4.05	921
Castrovillari.....	78.1	±3.59	±3.53	1364
Cosenza.....	77.5	±3.58	±3.57	2239
Paola.....	78.2	±3.75	±3.70	1220
Rossano.....	78.2	±3.67	±3.59	763
Gerace.....	79.0	±4.05	±4.00	1186
Palmi.....	78.2	±3.81	±3.79	1273
Reggio Calabria.....	79.8	±3.94	±3.88	1395
Caltanissetta.....	79.7	±3.55	±3.51	1328
Piazza Armerina.....	78.9	±3.33	±3.30	1069
Terranova.....	79.8	±3.72	±3.72	818
Acireale.....	80.4	±4.10	±3.95	1306
Caltagirone.....	79.9	±3.74	±3.70	1248
Catania.....	79.6	±3.77	±3.63	2384
Nicosia.....	79.0	±3.48	±3.44	1088
Bivona.....	79.6	±3.66	±3.61	737
Girgenti.....	80.3	±3.85	±3.78	2259
Sciacca.....	80.0	±3.77	±3.72	623
Castroreale.....	78.7	±3.76	±3.71	1071
Messina.....	79.6	±3.45	±3.42	2215
Mistretta.....	78.2	±3.48	±3.46	627
Patti.....	77.9	±3.68	±3.66	1104
Cefalù.....	79.2	±3.62	±3.47	1158
Corleone.....	78.8	±3.81	±3.80	661
Palermo.....	79.3	±3.77	±3.73	4504
Termini.....	78.5	±3.44	±3.42	1437
Modica.....	80.8	±3.60	±3.56	1846
Noto.....	80.5	±3.67	±3.61	803
Siracusa.....	80.3	±3.73	±3.67	1092
Alcamo.....	79.1	±3.52	±3.49	870
Mazara del Vallo.....	79.8	±3.59	±3.57	913

CIRCONDARIO	CE- PHALIC INDEX	VARIA- BILITY	CORRECTED VARIA- BILITY	NUMBER OF CASES
Trapani.....	80.6	±3.26	±3.24	1365
Cagliari.....	77.5	±4.32	±4.11	1533
Iglesias.....	77.2	±3.98	±3.79	590
Lanusei.....	76.4	±3.56	±3.46	648
Oristano.....	77.2	±3.74	±3.56	1330
Alghero.....	78.6	±3.96	±3.89	390
Nuoro.....	77.2	±3.97	±3.92	558
Ozieri.....	77.4	±3.71	±3.64	405
Sassari.....	78.4	±3.79	±3.73	826
Tempio.....	79.0	±3.49	±3.47	299

shows considerable differences in various parts of each *circondario*. For this reason we have assumed the variability to be the same in all the *mandamenti* of the *circondario*, and then reduced the total variability accordingly. If the average cephalic indices of the *mandamento* and *circondario* are respectively i_m and i_c , and the unreduced standard deviation of the whole *circondario* is σ_1 , the reduced variability of the cephalic indices of the *circondario* σ , then

$$\sigma^2 = \sigma_1^2 - [(i_m - i_c)^2],$$

where brackets indicate the process of averaging.

In this way the foregoing values have been obtained.

The map (pl. III) has been constructed by assuming the variability here given for the center of each *circondario* and interpolating between neighboring *circondari* in the same way as is done in meteorological maps, in maps of density of population,—a method that has been applied to anthropological data by Dr Jan Czekanowski. Of course, the lines are only approximate, particularly where the *circondari* are large.

Before taking up the discussion of the observed distribution of variabilities, it is necessary to discuss the accuracy of the values obtained by the method just described.

Owing to the inaccuracies of the measurements on which this study is based, it seems necessary to investigate in how far these inaccuracies exert a uniform influence over the variabilities given in Dr Livi's tables, particularly whether there are regions in which unusual accuracy or inaccuracy unduly decreases or increases the

variability of the index. Dr Livi has called attention to these inaccuracies and to the fact that in many cases the measurements of length and width of head have been rounded off to the nearest half-centimeter,¹ and that, owing to this procedure, certain indices occur rarely or not at all. This phenomenon is expressed clearly in all the graphical representations of the distribution of cephalic indices. In order to obtain a clearer insight into the process of rounding off, we have assumed that the true distribution for every *circondario* follows the exponential law—an assumption which, of course, is only an approximation. We then determined the ratio between the value found in the theoretical distribution and that in the observed distribution. The foregoing table gives the results of our study.

From this table we have calculated the ratio between the observed frequencies and the theoretical frequencies (the observed divided by the theoretical frequencies). Livi has shown that, when the cephalic index is calculated from diameters given in half-centimeters, the indices 90, 88, 87, 85, and 80 must be rare, while 86 and 79 must be frequent. This phenomenon appears very clearly in the following table, and it may be observed that the tendencies are quite evenly distributed over all the provinces, so

CEPHALIC INDEX	73	74	75	76	77	78	79	80	81
Liguria.	—	—	—	—	—	0.68	1.05	0.78	0.87
Lombardia.	—	—	—	—	—	—	—	—	0.89
Veneto.	—	—	—	—	—	—	—	—	0.89
Emilia.	—	—	—	—	—	—	—	—	0.86
Toscana.	—	—	—	—	—	0.91	1.25	0.79	0.82
Marche.	—	—	—	—	—	—	—	0.78	0.86
Umbria.	—	—	—	—	—	—	—	0.82	0.86
Lazio.	—	—	—	—	1.12	1.04	1.37	0.79	0.96
Abruzzi.	—	—	—	—	—	1.05	1.28	0.83	1.07
Campania.	—	—	—	—	—	1.04	1.23	0.81	0.97
Puglie.	—	—	—	1.19	1.11	0.98	1.33	0.83	0.96
Basilicata.	—	—	—	—	1.00	1.09	1.19	0.81	1.06
Calabrie.	—	1.23	1.03	1.29	1.02	1.11	1.24	0.72	0.84
Sicilia.	—	—	0.90	1.16	1.04	1.10	1.31	0.79	0.94
Sardegna.	0.96	1.41	1.02	1.26	0.91	1.09	1.09	0.67	0.84

¹ L'indice cefalico degli Italiani, *Archivio per l'Antropologia e la Etnologia*, vol. xvi (1886), p. 253; *Antropometria Militare*, pp. 80 et seq.

CEPHALIC INDEX	82	83	84	85	86	87	88	89	90
Piemonte.....	0.98	0.96	1.22	0.76	1.27	0.84	0.81	1.61	0.67
Liguria.....	1.16	1.06	1.44	1.08	1.44	—	—	—	—
Lombardia.....	1.11	0.99	1.29	0.85	1.17	0.82	0.79	1.40	—
Veneto.....	1.09	1.00	1.26	0.84	1.21	0.82	0.79	1.40	—
Emilia.....	1.01	0.95	1.24	0.83	1.18	0.84	0.76	1.45	—
Toscana.....	1.01	0.92	1.16	0.72	1.11	0.83	—	—	—
Marche.....	1.10	0.93	1.13	0.67	1.37	0.74	0.73	—	—
Umbria.....	1.06	1.00	1.21	0.82	1.13	0.79	0.82	—	—
Lazio.....	0.97	0.93	1.05	0.67	1.13	—	—	—	—
Abruzzi.....	1.14	0.97	1.09	0.68	1.19	—	—	—	—
Campania.....	1.07	1.07	1.17	0.71	1.09	—	—	—	—
Puglie.....	1.05	0.89	1.04	—	—	—	—	—	—
Basilicata.....	1.01	0.99	1.08	0.77	—	—	—	—	—
Calabrie.....	0.87	0.88	—	—	—	—	—	—	—
Sicilia.....	0.94	0.92	1.06	—	—	—	—	—	—

that we have no reason to suppose that the method of observation was materially different in different areas.

The unweighted averages of this series give the following results, which indicate, in connection with the preceding table, that approximately the same errors are found in all the different parts of the country.

Cephalic index	Ratio between observed and theoretical frequency
73	0.96
74	1.32
75	0.98
76	1.22
77	1.03
78	1.00
79	1.23
80	0.78
81	0.91
82	1.04
83	0.96
84	1.17
85	0.78
86	1.21
87	0.81
88	0.78
89	1.46
90	0.67

The question then presents itself, what the relation may be between the true variability and the one derived from Livi's material. In order to examine this point we may compare the general data for Reggio Emilia obtained by Livi himself with an exact instrument¹ and the observations in his *Antropometria Militare* (p. 237).

1. Livi's own observations, $\sigma^2 = 12.61$, 1145 cases.

2. General statistics, $\sigma^2 = 15.89$, 2831 cases.

The difference in σ^2 is therefore 3.28, which indicates the amount of inaccuracy introduced by the process of rounding off and by errors of measurement.²

	LIVI		BOAS		Diff.	Error
	σ^2	Cases	σ^2	Cases		
Caserta	14.44	7407	11.40	119	-3.04	± 1.7
Chieti	18.01	3760	12.13	63	-5.88	± 2.6
Campobasso	13.61	3826	14.76	82	+1.15	± 2.2
Avellino	15.61	4095	12.89	163	-2.72	± 1.6
Napoli	12.35	9109	8.06	210	-4.29	± 1.0
Salerno	14.89	5687	13.50	441	-1.39	± 1.0
Bari	15.78	7285	9.42	147	-6.36	± 1.5
Potenza	16.00	5898	13.25	544	-2.75	± 0.9
Cosenza	13.48	5586	14.88	244	+1.40	± 1.3
Messina	12.85	5017	11.26	431	-1.59	± 0.8
Palermo	13.33	7760	9.27	1240	-4.06	± 0.4
Trapani	12.07	3148	10.95	90	-1.12	± 1.7
Caltanissetta	11.67	3215	9.17	65	-2.50	± 1.8
Girgenti	14.53	3619	9.68	175	-4.85	± 1.3
Catania	14.77	6026	10.31	170	-4.36	± 1.3

We have also investigated this question by comparing Livi's observations with those taken on American immigrants. The material thus discussed consists of the family observations included in the study of American immigrants and their descendants.³ In the comparison of these data it must be borne in mind that the place of birth of the immigrants is not as accurately determined as

¹ L'indice cefalico degli Italiani, *Archivio per l'Antropologia e la Etnologia*, vol. xvi, p. 252.

² We do not know whether Livi's own observations are contained in the larger series. If they are contained in it, the inaccuracy would be a little larger; the difference in σ^2 would be about 5.

³ Franz Boas, *Changes in Bodily Form of Descendants of Immigrants*.

that of the individuals recorded in Livi's military statistics, and that certain errors may have been introduced by lack of accurate information bearing on this point. The foregoing table contains the results of this comparison.

The average difference resulting from these series, taking into consideration the errors, is 2.91 in favor of the series measured in America. If we disregard the effect of rounding off, which it is not quite easy to take into account, since we have no data indicating how many measurements in each series have been rounded off, we may determine the inaccuracy of the measurement on this basis. If we call breadth and length of head b and l respectively, the individual's variations x and y , the errors v and w , the head-index c , then

$$c = 100 \frac{b + x + v}{l + y + w};$$

and with sufficient accuracy,

$$c = 100 \frac{b}{l} + 100 \frac{b}{l} \left(\frac{x}{b} - \frac{y}{l} + \frac{v}{b} - \frac{w}{l} \right).$$

$$\sigma_1^2 = 10,000 \frac{b^2}{l^2} \left[\left(\frac{x}{b} - \frac{y}{l} \right)^2 \right] + 10,000 \frac{b^2}{l^2} \left[\left(\frac{v}{b} - \frac{w}{l} \right)^2 \right].$$

Here $10,000 \frac{b^2}{l^2} \left[\left(\frac{x}{b} - \frac{y}{l} \right)^2 \right] = \sigma^2$, the variability of the head-index unaffected by errors of observation. We may write, therefore,

$$\sigma_1^2 - \sigma^2 = 10,000 \frac{b^2}{l^2} \left(\frac{[v^2]}{b^2} + \frac{[w^2]}{l^2} \right).$$

We have, of course, no means of determining the errors in b and l separately, and may assume that errors in the two measurements are approximately equal. We will call the mean square error in these measurements s^2 . Then

$$\sigma_1^2 - \sigma^2 = 10,000 s^2 \frac{b^2}{l^2} \left(\frac{1}{b^2} + \frac{1}{l^2} \right).$$

If we assume b and l as approximately 150 mm. and 190 mm., the values characteristic of southern Italy, we find

$$\begin{aligned} \sigma_1^2 - \sigma^2 &= .52s^2 \\ s^2 &= 5.6 \\ s &= \pm 2.4 \text{ mm.} \end{aligned}$$

In other words, the mean square error, including the effect of rounding off, of length of head and width of head in the general statistics of the *Antropometria Militare*, must be about ± 2.4 mm.

The difference between the variability obtained by Livi and that obtained from the series of immigrants is fairly uniform. There are only two regions where the variabilities obtained by Livi are less than those obtained from the study of the immigrants. These regions are Campobasso and Cosenza. The series of mean square errors of the differences shows clearly that the variations in our results are, on the whole, unimportant. The differences for Palermo, however, suggest an exceptionally great inaccuracy.

We have also compared the averages obtained by Livi and those obtained by the measurements of immigrants. The results of this comparison are given in the following table.

	LIVI		BOAS		Diff.	Error
		Cases		Cases		
Caserta.....	81.8 $\pm$ 3.80	7407	80.3 $\pm$ 3.38	119	-1.5	$\pm$ 0.3
Chieti.....	83.3 $\pm$ 4.24	3760	81.9 $\pm$ 3.48	63	-1.4	$\pm$ 0.4
Campobasso.....	81.6 $\pm$ 3.69	3826	82.0 $\pm$ 3.84	82	+0.4	$\pm$ 0.4
Avellino.....	81.4 $\pm$ 3.95	4095	80.6 $\pm$ 3.59	163	-0.8	$\pm$ 0.3
Napoli.....	82.6 $\pm$ 3.51	9109	80.9 $\pm$ 2.84	210	-1.7	$\pm$ 0.2
Salerno.....	82.7 $\pm$ 3.86	5687	81.0 $\pm$ 3.67	441	-1.7	$\pm$ 0.2
Bari.....	80.7 $\pm$ 3.97	7285	79.6 $\pm$ 3.07	147	-1.1	$\pm$ 0.3
Potenza.....	80.8 $\pm$ 4.00	5898	81.3 $\pm$ 3.64	544	+0.5	$\pm$ 0.2
Cosenza.....	77.9 $\pm$ 3.68	5586	77.6 $\pm$ 3.86	244	-0.3	$\pm$ 0.2
Messina.....	78.8 $\pm$ 3.58	5017	77.8 $\pm$ 3.36	431	-1.0	$\pm$ 0.2
Palermo.....	79.1 $\pm$ 3.66	7760	77.6 $\pm$ 3.04	1240	-1.5	$\pm$ 0.1
Trapani.....	80.0 $\pm$ 3.47	3148	78.7 $\pm$ 3.30	90	-1.3	$\pm$ 0.4
Caltanissetta.....	79.4 $\pm$ 3.42	3215	78.3 $\pm$ 3.03	65	-1.1	$\pm$ 0.4
Girgenti.....	80.1 $\pm$ 3.81	3619	78.8 $\pm$ 3.10	175	-1.3	$\pm$ 0.3
Catania.....	79.7 $\pm$ 3.85	6026	77.8 $\pm$ 3.20	170	-1.9	$\pm$ 0.3

It will be seen that almost everywhere the cephalic index obtained in America is less than the cephalic index obtained in Italy, the difference being, on the average, 1.03 units. Here, again, there are only two regions where the average index in America exceeds the index found in Europe. These regions are Campobasso and Potenza. It does not seem improbable that the average value in America may be affected in some cases by the uneven representation

of different parts of the same province, which would naturally result in an index different from the one found in Italy. We think, however, that the regular difference is due to differences in the method of measuring. It is a well-known fact that in hasty observations errors in the length of the head must almost always result in values which are a little below the true value, because a change in the point on which the compasses are placed in front, and a deviation from the medial line on the occiput, will both result in a shortening of the line measured. The only cause of excessive measurements in the length of head is found in the slipping of the compasses when they are taken off, and this is usually one of the first errors that observers guard against.

On the other hand, rapid measurement of the width of the head is liable to result in increased values, when the measurement is not taken in an accurately transversal direction; in other words, if one of the points of the compasses is a little more forward than the other one. In this case the diagonal measurements are always greater than the true measurements. On the other hand, inexperienced observers are quite liable to obtain too small results in cases where they do not move the compasses far enough back. On the whole, we might therefore expect, in measurements taken by observers without a great deal of experience in anthropometric work, and necessarily very rapidly, that the length of the head would be too small and the width of the head approximately accurate.

We have calculated from the data contained in the preceding table the error which would result in the observed difference, provided that an equal error, but in opposite directions, were made in the length of the head and the width of the head. This error (in other words, the average personal equation of the observers) would be -1.03 mm. If the error is calculated on the assumption that the width of the head is correctly given and an error made in the length of the head, the latter error would be -2.48 mm.

We may, therefore, infer that the material presented by Livi gives, on the whole, an adequate basis of a discussion of the variability of the cephalic index, provided we confine ourselves to the material collected according to Dr Livi's methods. We have no

means of determining whether the values of Emilia should not be slightly increased, since Dr Livi's accurate measurements may be contained in them.

A glance at the map shows that, on the whole, the largest variabilities are found in central Italy where the two distinct types of northern Italy and of southern Italy have intermingled.

Before we discuss this distribution in greater detail, it remains to be shown that the amount of increase of variability of the cephalic index due to the mixture of two types like the South Italian and North Italian is large enough to account for the increase that has been observed. The maximum variability is found in Macerata, and is ± 4.68 ; its square 21.90. The average index for this *circondario* is 83.7. If we imagine this type composed of one type of an index of about 86 representing northern Italy and one of an index of about 79 representing southern Italy, we must assume that the latter occurs with a frequency of 0.5 of the former. If we assume the variabilities of the component elements as ± 3 , then the square of the total standard variability would be 22.3, approximately the value found in Macerata.¹ This, of course, is intended only as an indication that the increases of variability *may* be produced by such mixture, not as an analysis of the series, which would be quite arbitrary on the basis of available observations.

It seems to us, therefore, that the distribution of the amounts of the observed differences in the variability of the cephalic indices agrees, on the whole, with the theory with which we started. Since, furthermore, the theory is in accord with observations quoted before, it seems to be a plausible explanation of the observed facts.

We are not inclined, however, to claim that mixture is necessarily the sole reason for the distribution of variabilities. It might

¹ If the frequency of the type with average index 86 is called r , that of the type with average index 79 is called n ,

$$\frac{86 + 79n}{1 + n} = 83.7;$$

and the variability of the whole series, 9 being the square of the component series, and their distances from the general average 2.3 and 4.7 respectively,

$$\sigma^2 = 9 + \frac{2.3^2 + n4.7^2}{1 + n}$$

very well be that certain local causes increase or decrease the variability of the cephalic index. We shall revert to this subject later. It would seem, however, a curious coincidence if the region, of increased variability due to environmental causes should be the same as the one where we should expect increased variability due to mixture.

One objection that might be raised against our interpretation of the observed facts deserves mention. If the population were very mobile, it might be that people of adjoining parts of the country lived in any particular district, and that therefore without any inter-marriage the variability might be increased wherever there are considerable changes in the cephalic index over short distances. The census of the country districts shows, however, that this is not the case. Even if we admit a very extended migration over a radius of about 60 miles, so that there should be an even distribution of types over such an area, a simple calculation shows that the increase of the variability due to this cause, considering only individuals of one generation, would be so small that it could not account for the differences in variability in different parts of the country. For instance, in one of the districts where extreme values of the cephalic index come near together, in Camarino, in the Province of Macerata, the square of the standard variability, with an even distribution of all the types occurring in the adjoining *circondari*, would be increased by about 1.5 units, while in reality it exceeds the lowest values found in Italy by 9 units. It appears, therefore, that if the increased variability is to be explained as due to mixture of types, it must be an old and much more extended mixture.

A few regions of Italy offer points of special interest when considered from these points of view. While in the greater part of the valley of the Po a uniformly low variability prevails, there is a very rapid increase westward toward the French border. In this region the long-headed Ligurian type comes into close contact with the short-headed Alpine type; and in those areas where the variability is great, the transition from long-headed to short-headed areas is very rapid. In Tuscany, particularly on the western coast,

the conditions are similar, the type of the region of Lucca contrasting strongly with the type of the interior. It is rather interesting to note that in both these areas the increase of variability is in the interior, as though the influence of the mountain people on the coast type had been very slight, the reverse influence strong. All along the western coast of Italy the variabilities remain rather low, although between Tuscany and the region south of Rome they are relatively high. By far the highest values are found on the Adriatic side, in the Apennine region. It is conceivable that the fact that Italy faces here the Balkan peninsula, the northern parts of which are occupied by round-headed people, may have exerted an influence upon the head-forms. If South Italians, types of the Po valley, types of the Balkan peninsula, and Ligurians intermingled here and retained their types, high variabilities like those found here would result. It is noteworthy, however, that in Larino and Sansevero the variability is low, although Slavic and Albanese colonies have existed there for a long period.¹ Farther to the south there is a minimum of variability in the district crossing Italy between points near Naples and Foggia, while farther south the values are rather low and quite uniform. They vary around ≈ 3.75 , one of the dividing-lines of groups selected for our map; so that the uniformity is somewhat obscured by the occurrence of two zones in this area, which, however, represent values very much alike. Higher values are found in a small district inland, east of Naples, where the variability is almost ≈ 4 . Another district of higher variability is situated in southern Calabria, where a considerable infusion of Albanese blood has occurred. Livi has shown that there is no appreciable difference in type between the inhabitants of Italian and Albanese villages of Calabria; but it is quite possible that the whole area may be affected by the infusion of Albanese blood which has continued for more than four hundred years. There is no trace of a disturbing influence in the ancient Illyrian territory in southern Italy.

Notwithstanding all the irregularities of distribution of varia-

¹ F. L. Pullé, *Profilo Antropologico dell' Italia*, *Archivio per l'Antropologia*, 1898, xxviii, pp. 110 et seq., pl. II.

bility of the cephalic index, the fact remains that in a broad strip occupying the middle portion of the country,—roughly speaking, between Ravenna and Chieti on the Adriatic side, Lucca and Rome on the Ligurian and Tirrenian side,—the bulk of high variabilities are found.

Before we turn to the consideration of these data from another standpoint, we desire to call attention to the fact that the mixture which has taken place in central Italy extends over very long periods, so that opportunity for Mendelian segregation would present itself. The conditions are the same among the Lycian Greeks whom Dr von Luschan discusses. In that area the difference between the component types is so great that the very high variability of ± 6.8 results,—a value which is not equaled in any territory where a fairly homogeneous population resides.

It would seem that similar increases of variability occur in other areas where a long-continued mixture of types may be proved to exist. Thus the Alaskan Eskimo, who are undoubtedly a mixture of long-headed eastern Eskimo and of short-headed northwestern Indians, have the high variability of ± 4.3 ,¹ while the Indians have a variability of only about ± 3 .¹ In California, where the long-headed Yuki, who have an average index of 77.4, adjoin shorter-headed tribes, the former have a variability of ± 2.9 (48 cases); the neighboring Pomo, an average index of 81.0 ± 3.8 (28 cases); the Maidu and Pit River jointly, of 80.5 ± 3.7 (68 cases).²

In British Columbia, Washington, and Oregon similar phenomena seem to occur, although they are not so clear.

The anthropometric and ethnological evidence indicate that a mixture of several types has occurred in the area of the Lower Fraser river and in the Lillooet valley, and here the highest variabilities are found. In Oregon, where we approach the types of

¹ These data have been computed from the materials published in F. Boas, *Zur Anthropologie der nordamerikanischen Indianer*, *Verhandlungen der Berliner Gesellschaft für Anthropologie, Ethnologie und Urgeschichte*, xxvii [1895], p. 391; and *Physical Characteristics of the Tribes of British Columbia*, *Twelfth and Final Report on the North-Western Tribes of Canada* [1898], pp. 628 et seq.

² See F. Boas, *Anthropometry of Central California*, *Bulletin of the American Museum of Natural History*, xvii [1905], pp. 347-380.

California with more elongated heads, the variability of the cephalic index rises again. The numbers of cases at our disposal are, however, so small that these values must be taken as indications only, not as the true expression of the actual conditions.

	CEPHALIC INDEX	CASES
Haida, Nass, Tsimshian	82.7 $\pm$ 3.1	110
Bellacoola, Kwakiutl	84.3 $\pm$ 3.1	61
Delta and Canyon of Fraser River	86.0 $\pm$ 3.5	134
Harrison Lake	88.7 $\pm$ 4.0	35
Lillooet	86.0 $\pm$ 3.7	103
Upper Thompson	83.2 $\pm$ 3.6	135
Shuswap	84.5 $\pm$ 3.1	213
Coast of Washington	84.2 $\pm$ 3.3	40
Tinneh of Oregon	84.0 $\pm$ 3.7	57

The values of these variabilities are throughout higher than those found in areas of uniform populations. Thus we find for some of the provinces of Sweden¹ variabilities of less than $\pm$ 3. For Denmark, not divided into provinces, it is $\pm$ 3.29 for males, $\pm$ 3.26 for females,² which probably indicates a value of $\pm$ 3 or less for the separate districts.

A few other cases of increase of variability due to mixture have been described.³ Among immigrants who come to America from various parts of Europe the variability of the cephalic index of children of one family is the greater, the greater the difference between the parents. This observation has been made among Jews and Italians. Only families are considered here in which father and mother belong to the same nationality. Evidently this may be explained in accordance with Mendelian principles by assuming the head-index to be determined by a number of unit characters, and each individual to represent a combination that may be expressed by the complex $a_1a, b_1b, c_1c \dots ll, mm, nn \dots$, in which group the characters without index express the unit characters common to father and mother, while those with index

¹ Gustaf Retzius and Carl M. Fürst, *Anthropologia Suecica*, pp. 90-91.

² Carl Burrau, Om Hovedets Formog Størrelse, *Meddelelser om Danmarks Antropologi*, I, p. 245.

³ Franz Boas, *Changes in Bodily Form of Descendants of Immigrants (Final Report)*, pp. 77, 153-154.

express those that belong to father or mother alone. Then a massing of the values of the head-index around the racial type, with secondary maxima for the paternal and maternal values, may result.

We have also data for the width of face of half-bloods, the children of American Indian mothers and white fathers.¹ The observed distributions give the following widths of face:

Indians.....	149.8	± 5.56	(3018 cases)
Half-bloods.....	145.8	± 5.70	(594 cases)
Whites.....	(140.0)	± (5.20)	

Since the descent of the white fathers is not accurately known, we have introduced an approximate value. The increase of the variability of the half-bloods of the first generation is so small that we may say that the series, so far as its variability is concerned, seems to behave like a blend of two homozygous types. The increase in variability, due to the difference of distinct parental types that has been observed in intraracial marriages, does not appear here. Nevertheless the distributions observed among the half-bloods indicate a massing of observations near the Indian type and near the European type. In Mendelian terms this would have to be expressed in the same manner as the preceding case, namely, by the assumption that, in regard to width of face, both Indian and white are heterozygous, and contain certain elements in common, without appreciable dominance of any of the unit characters concerned.

The Mendelian formula, however, seems to involve an hypothesis that does not seem quite plausible, and we prefer to express the observed phenomena in another manner. Considering the observed similarities of members of fraternities and the similarities between individuals and their ancestors, we may say that the variability in fraternities is due to the varying intensity of transmission from individuals of the ancestral series, and that the intensity of hereditary transmission decreases with the remoteness of the ancestral relations. If we assume, then, that the hereditary feature is due

¹ Franz Boas, *Zur Anthropologie der nordamerikanischen Indianer*, *Verhandlungen der Berliner anthropologischen Gesellschaft*, 1895, pp. 404-408.

to the reappearance of ancestral types, and that there is always part of the paternal and part of the maternal line present, then the observed facts of segregation would be due to the presence of the same types of ancestors (or of the same ancestors) in the two lines. It will readily be seen that when we express the phenomena of heredity in these terms, the observations among Jews and among Indian half-bloods would be adequately covered. In the former case we should say that both father and mother have to a great extent the same ancestors which will reappear in the series; that, however, since both parents differ very much, similar differences may have occurred also among their more immediate ancestors. Therefore, on account of the stronger recurrence of the types of near ancestors, there will be a certain amount of massing at or near the paternal and maternal types.

In the case of the Indian half-bloods we should say that whenever characters of equidistant ancestral groups appear in the two lines, and neither is dominant, there will be a massing around the mixed type; whenever the characters of ancestral groups appear that are not equidistant in the two lines, the paternal or the maternal type will have the greater influence, according to which line is represented by the nearer, and therefore more potent, ancestors.

If we express the phenomena of inheritance in this manner, the observations showing the purity of the segregated recessive lines compel us to say that, when there has been a reversion to a certain ancestral trait in one line, then the later generations of ancestors in that line will have no influence on the descendants of the individual in question.

While the distribution of the variabilities of the cephalic index thus favors the theory of the permanence of the two fundamental types of northern and southern Italy throughout the period of their intermixture, the study of the variabilities found in cities indicates that environmental causes modify the values of the cephalic index. For many years all the large cities of Italy have had a considerable influx of a population born at great distances. This is true particularly of Rome, and the complex character of the descent of its population has been set forth by Livi. The relative

frequency of the native and foreign-born element of a number of large cities is contained in the following table, which has been extracted from the Census for 1901.

INHABITANTS ACCORDING TO PLACE OF BIRTH OF ELEVEN CITIES
(HUNDREDS)

BORN IN	TORINO	GENOVA	MILANO	TREVISO	VENEZIA	BOLOGNA	FIRENZE	ROMA	NAPOLI	MESSINA	PALERMO
City.....	865	579	1027	100	508	406	542	1089	1921	615	1117
Rest of province....	321	175	539	33	44	174	182	258	250	56	180
Piemonte.....	235	92	95	1	7	10	15	55	12	3	4
Liguria.....	19	11	17	—	5	3	5	13	6	1	5
Lombardia.....	51	48	441	2	14	12	12	38	16	3	7
Veneto.....	21	36	76	21	33	14	16	30	10	1	7
Emilia.....	21	59	84	3	12	64	28	77	13	2	3
Toscana.....	20	38	30	1	7	12	97	87	15	2	6
Marche.....	5	10	11	1	7	9	10	210	8	1	1
Umbria.....	2	3	5	—	1	2	7	110	6	—	1
Lazio.....	6	7	10	—	3	3	10	—	16	3	3
Abruzzi.....	4	10	6	—	3	4	5	184	40	1	3
Campania.....	8	19	18	1	6	5	15	114	264	10	12
Puglie.....	5	6	10	1	7	3	5	23	47	2	2
Basilicata.....	1	2	1	—	1	—	1	5	16	1	1
Calabria.....	2	7	3	—	2	1	2	15	39	17	5
Sicilia.....	12	18	13	3	7	3	7	31	44	24	187
Sardegna.....	5	6	3	—	1	1	2	7	3	1	2

Unfortunately the earlier census, which would express accurately the composition of the population for the parents of the men measured, is not available. Still it is quite certain that the influx of outsiders in cities like Genoa, Milan, and Rome must have continued for very long periods.

In the following table we give the values of the cephalic index and its variabilities for each of these eleven cities, and for the rest of the *circondario* in which they are situated. The values for the *circondari* were calculated from the data given in the full table for all the *mandamenti*, by excluding the *mandamento* representing the city, and by assuming again that all the *mandamenti* except the city had the same variabilities. The values for the cities were obtained directly from Livi's tables given on pp. 230-247. The table contains, furthermore, the theoretical averages which would

be obtained if all the values of the measurements according to the nativity of the people and their numbers as given in the census of 1901 were used, under the assumption that they would be preserved unchanged in the city.

	CEPHALIC INDEX			VARIABILITIES			NUMBER OF CASES		Differences between Cephalic Index of City and Circondario without City	
	City		Circondario without City	City		Circondario without City	City	Circondario without City	Differences between Cephalic Index of City and Circondario without City	
	Theoretical Value	Observed Value		Theoretical Value	Observed Value				Theoretical	Observed
Torino.....	85.5	85.6	86.3	±4.08	±3.85	±3.67	1391	3528	-0.8	-0.7
Venezia.....	83.7	83.8	85.7	±3.83	±3.62	±4.02	1101	1993	-2.0	-1.9
Treviso.....	85.1	85.4	85.1	±3.88	±3.77	±3.66	1098	2885	±0.0	+0.3
Bologna.....	84.2	83.9	84.7	±3.95	±3.84	±3.65	1380	2196	-0.5	-0.8
Milano.....	84.1	83.8	84.4	±3.61	±3.35	±3.32	1890	1660	-0.3	-0.6
Firenze.....	82.3	81.7	83.3	±4.30	±4.17	±4.15	1163	3625	-1.0	-1.6
Genova.....	82.7	82.1	82.7	±4.10	±3.77	±3.62	1552	1785	±0.0	-0.6
Napoli.....	82.4	82.6	82.6	±3.73	±3.66	±3.54	4623	920	-0.2	±0.0
Roma.....	81.4	79.9	80.4	±4.50	±4.04	±3.99	1384	1891	+1.0	-0.5
Messina.....	79.6	79.8	79.3	±3.56	±3.41	±3.43	1405	810	+0.3	+0.5
Palermo.....	79.6	79.5	79.0	±3.75	±3.64	±3.84	2524	1980	+0.6	+0.5

It will be noted that these theoretical values for the variabilities are very much larger than the observed values for the cities, and that the observed differences between the cities and the surrounding country for the variability of the cephalic index are trifling, in fact so trifling that a very large reduction of the foreign-born population would be necessary in order to make it possible to explain the changes without assuming coincident changes of types, due to city life. For Rome, for instance, it would be necessary to assume an immigration of less than one-twelfth of what it was in 1901 to obtain values at all comparable in regard to variability for the observed and the computed city values—provided the relative amount of influx has remained the same from all parts of the country. Furthermore, the values for the averages of the cephalic index in city and country contradict the results obtained from the variabilities alone. In short, considering the long-continued influx of foreigners into the cities, and the close agreement between the observed variabilities of city and of the country in which they are

situated, it seems necessary to assume that the head-index undergoes changes in the city. It is plausible that in Venice, which differs so much in environment from the surrounding country, the depression of the variability may be due to the strong influence of the environment.

It would seem, therefore, that the observations of the city-born population necessitate the assumption of a direct influence of city life on the cephalic type. This agrees with the conclusion reached from a study of the European immigrants in New York. It may be inferred from the New York observations that under the influence of city life the short-headed North Italians would become a little more long-headed, and the long-headed South Italians a little more short-headed. The theoretical values for averages obtained in Italy neither confirm nor contradict this assumption, while the theoretical values for variabilities that would be obtained under this assumption would show a much better agreement with the observed values than those resulting under the assumption of absolute stability of the component types.

The claim that the changes that do occur are due to natural selection cannot be proved, and does not seem to us favored by the American observations referred to before. The numerical values found for the Italian cities would also require an intensity of selection much greater than seems plausible. On the other hand, the manner of action and cause of a direct influence of city life on head-form remains so far entirely obscure.

Attention may also be called to the apparent massing of high variabilities in mountainous areas. This may perhaps be due to the fact that such areas have been for long periods places of refuge for individuals from different parts of the country who had to seek shelter from political or ecclesiastical persecution. However, the fact itself does not seem quite sufficiently established, and other explanations of the observed distribution seem possible.

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